Large-Scale, Low-Cost Parallel Computers Applied to Reflector Antenna Analysis

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This paper discusses the use of medium- to large-scale Beowulf-class computers in reflector antenna analysis, based on a discrete approximation of the radiation integral. Beowulf-class computers are defined as piles of PCs running LINUX, using fully mass-market, commercial, off-the-shelf (M^2COTS) components. The Beowulf-class systems used in this work consist of Pentium Pro processors and fast Ethernet (100Base-T) networking. Small systems can be purchased for approximately $1,700 per node as of December 1997. The system used in this work (named Naegling, and located at the California Institute of Technology) has been used in an n-body gravitational simulation with performance of over 10 GFLOPS.

The physical optics (PO) code used in this work (W. A. Imbriale and T. Cwik, "A Simple Physical Optics Algorithm Perfect for Parallel Computing Architecture," *10th Annual Review of Progress in Appl. Comp. Electromag.*, pp. 434-441, 1994) is based on a discrete approximation of the radiation integral (W. A. Imbriale and R. E. Hodges, "The Linear-Phase Triangular Facet Approximation in Physical Optics Analysis of Reflector Antennas," *Appl. Comp. Electromag. Soc. J.*, v. 6, pp. 52-73, 1991). This calculation replaces the actual reflector surface with a triangularly faceted representation so that the reflector resembles a geodesic dome. The PO current is assumed to be constant in magnitude and phase over each facet so the radiation integral is reduced to a simple summation. This program has proven to be surprisingly robust and useful for the analysis of arbitrary reflectors, particularly when the near-field is desired and the surface derivatives are not known.

This paper will include discussion of the parallelization of the PO code, as well as computational results obtained on varying numbers of processors of Naegling, up to the full machine size (currently 140 processors). The computational results will be compared with results obtained from other machines, such as the Intel Paragon and the Cray T3D.